Vinyl Record Auto-Flipper

Team 20

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Introduction

Project Function

The core purpose of the project is to provide a seamless transition for flipping a vinyl record without user input.

It integrates four subsystems: microcontroller, flipping mechanism, magnetic (Hall-Effect) sensor, and power delivery to operate.

Each subsystem collaborates with the other subsystems to operate.

Objective

Limitations with record players

Vinyl records are growing in popularity.

Records store around 6 minutes of music on each side (for 7 inch records), or around 20 minutes on each side (for 12 inch records).

This disrupts the listening experience.

We want to automate the record listening experience. Once you put the record on, it plays completely.

Requirements for success

Time-Constrained Flipping Sequence:

- We need it limited to **25 seconds maximum**.
- Value based on average ad lengths on Spotify, Youtube, and Max.

Accurate flipping of the record:

- We need **100% accuracy** when flipping record.
- Value calculated using mean time before failure of jukeboxes.

Accurate triggering of flipping at the right time

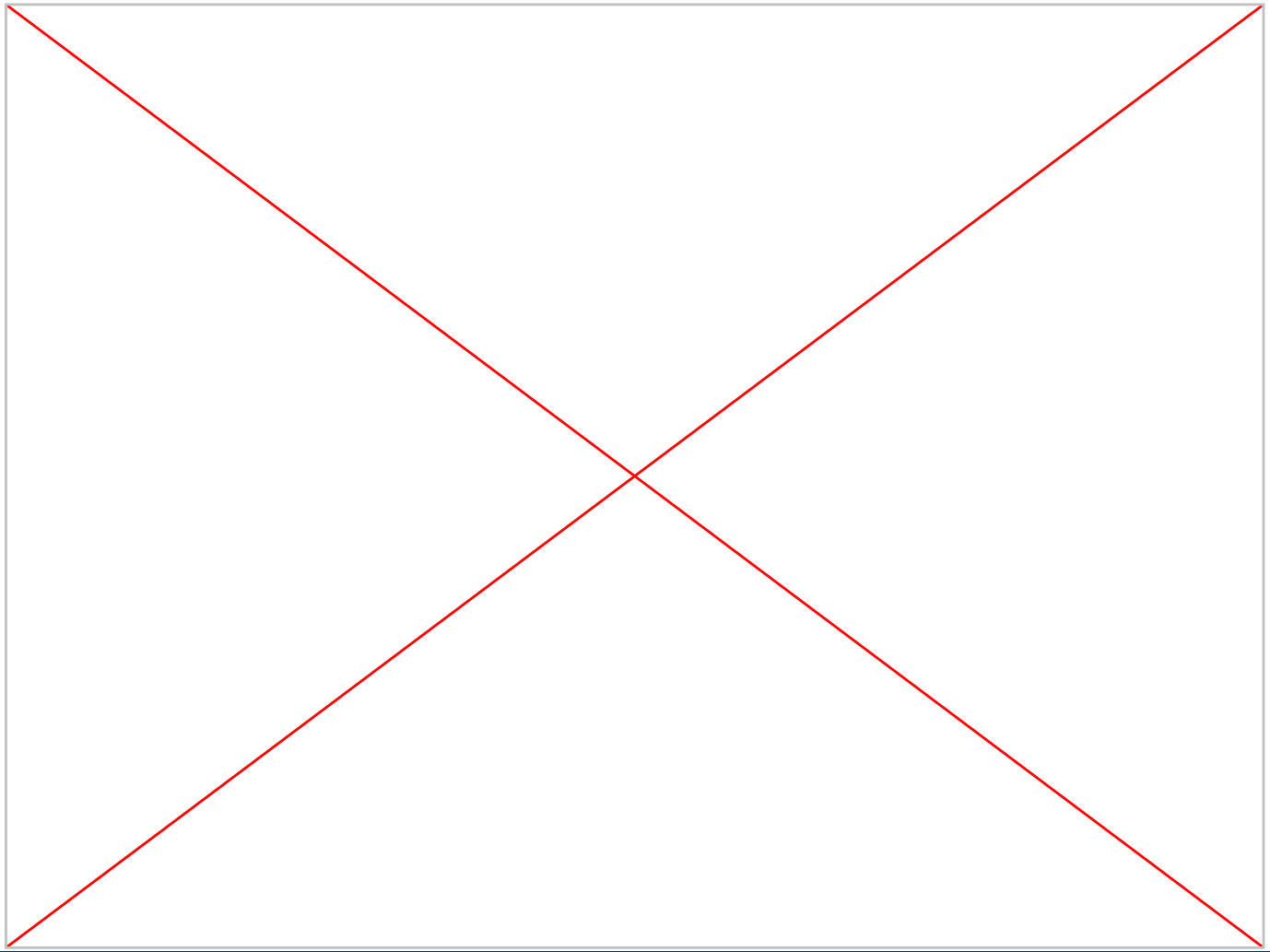
- We need **100% accuracy** to prevent disruption of listening and experience and damage of record

Our implementation

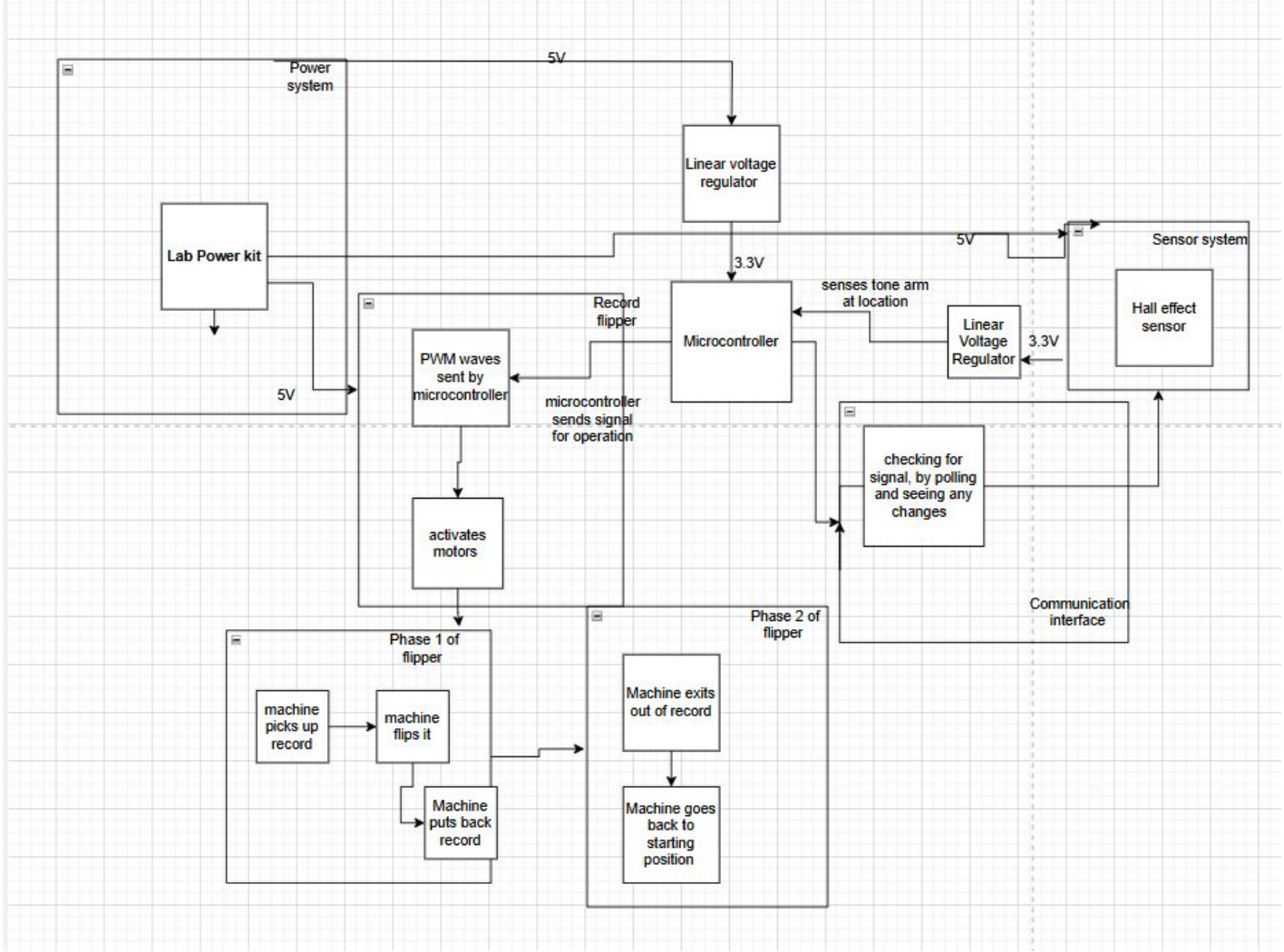
Mid-range: $160

Low-end: $35

Demonstration



Final Design Block Diagram



Subsystem #1 Microcontroller

Requirements and Verification Table

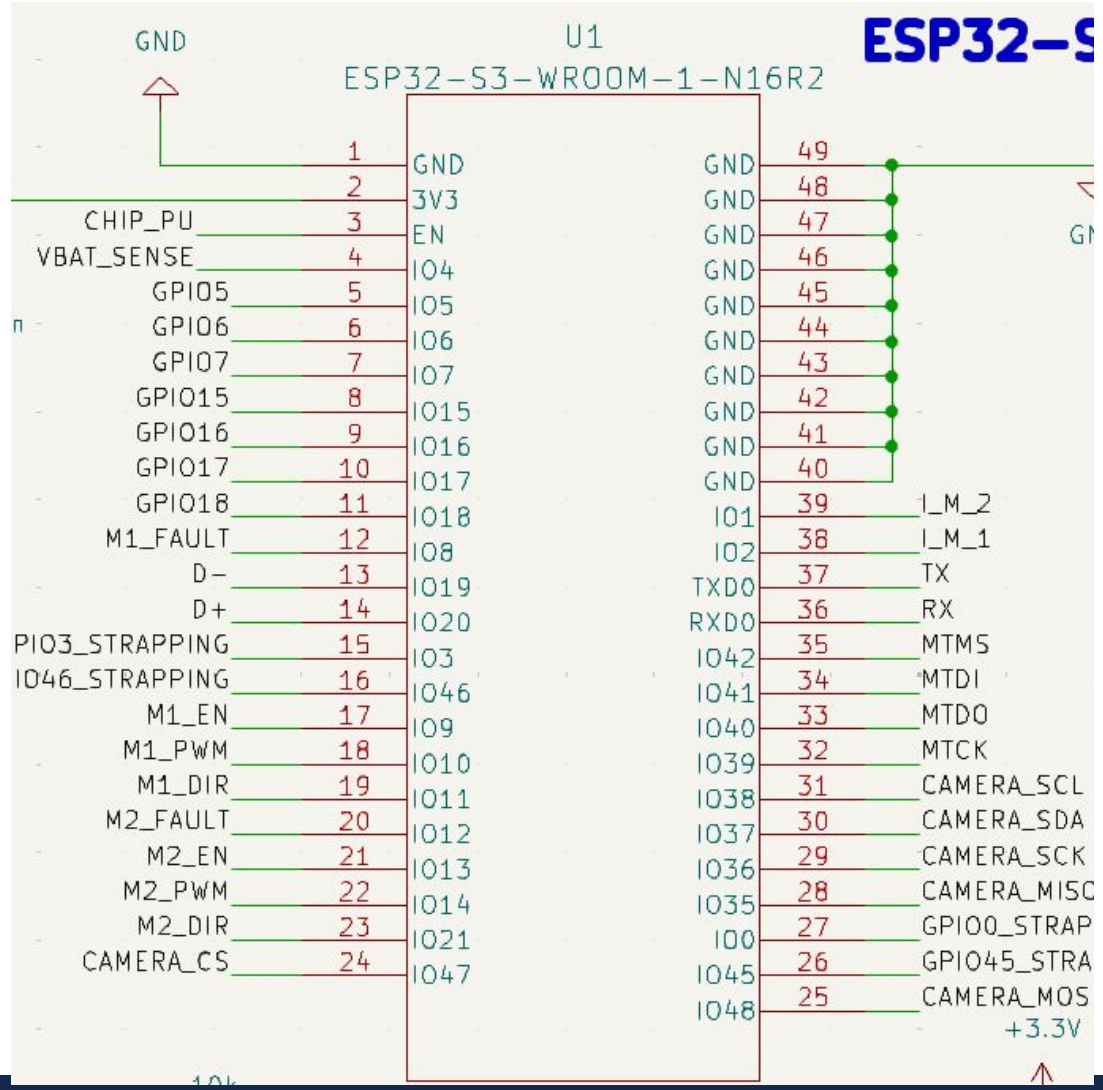
Requirement	Verification
Be able to send correct PWM waves for the servo in order to control it	We must first connect the microcontroller, make sure everything is powered on, and then we must use an oscilloscope in order to properly check the PWM waves.
Be able to properly take in signals in order to start the functions (I.E. flipper subsystem starts moving)	We will check for the input port of the ESP32 Controller and make sure that we are receiving the signal and show that the Microcontroller did it’s function properly

Circuit Diagram

Our Microcontroller was the ESP-32-S3-WROOM-1

Microcontroller was programmed through the Arduino IDE

Used the ESP32 Servo library to control the motors

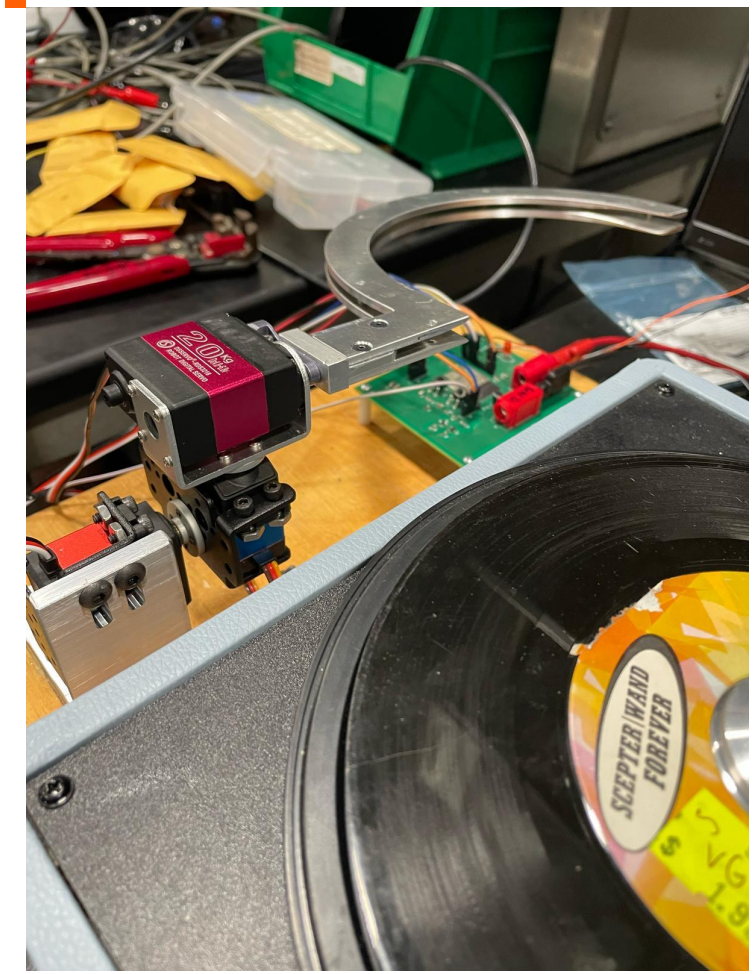


Subsystem #2
Flipping Mechanism

Requirements and Verification Table

Requirement	Verification
Make sure that any type of force applied by the flipper system ensures that it does not hurt or damage the flipper system.	Operate the flipper system's 50 times consecutively to make sure no damages are incurred.
Test that the motors are able to support the weight of holding the record player	We must first make the flipper system hold onto the record player and make sure that the base of the system is sturdy enough to not change direction in any sort of way

Flipping Mechanism Explanation



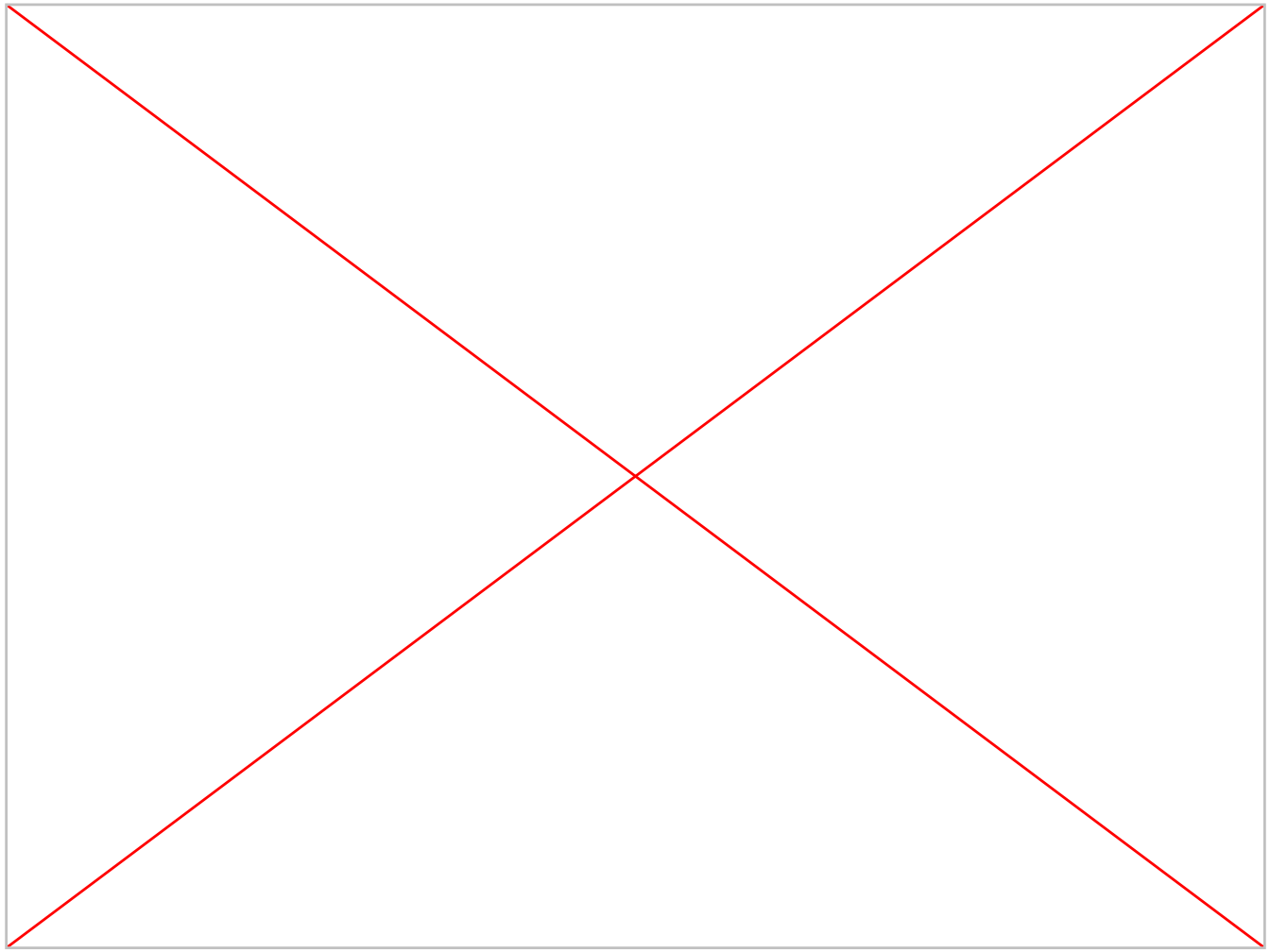
PWM Signals

The microcontroller sends a specified number of PWM signals to the motors to turn

One motor works at a time

All motors work individually and combine their work to complete the flipping mechanism

Testing 50 times consecutively

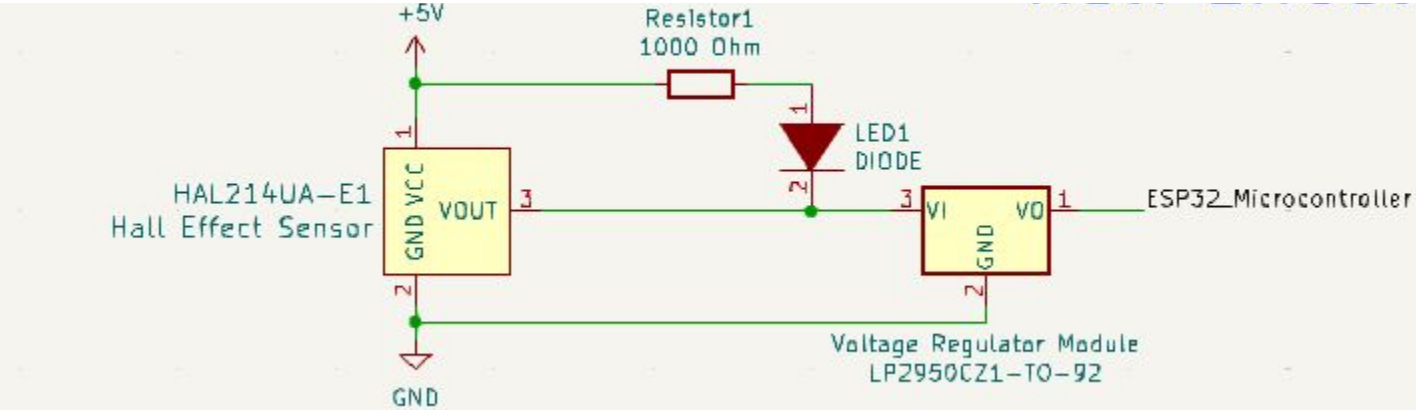


Subsystem #3
Hall-Effect Sensor

Requirements and Verification Table

Requirement	Verification
The sensor is able to detect when the tone-arm's magnet is nearby	The record finished playing and the tone-arm is in its resting position when sensor sends signal
Ensure the sensor does not send a signal when the tone-arm is not in its resting position.	The sensor does not false trigger from any unwanted magnetic fields
The microcontroller is able to read voltage jumps	Using multimeter to read the output voltage switching

Circuit Diagram



Circuit Explanation

The Hall-Effect Sensor receives a 5V input

The input and output are connected via a diode with the outlined connections

The Vout becomes 0V when magnetic field is present

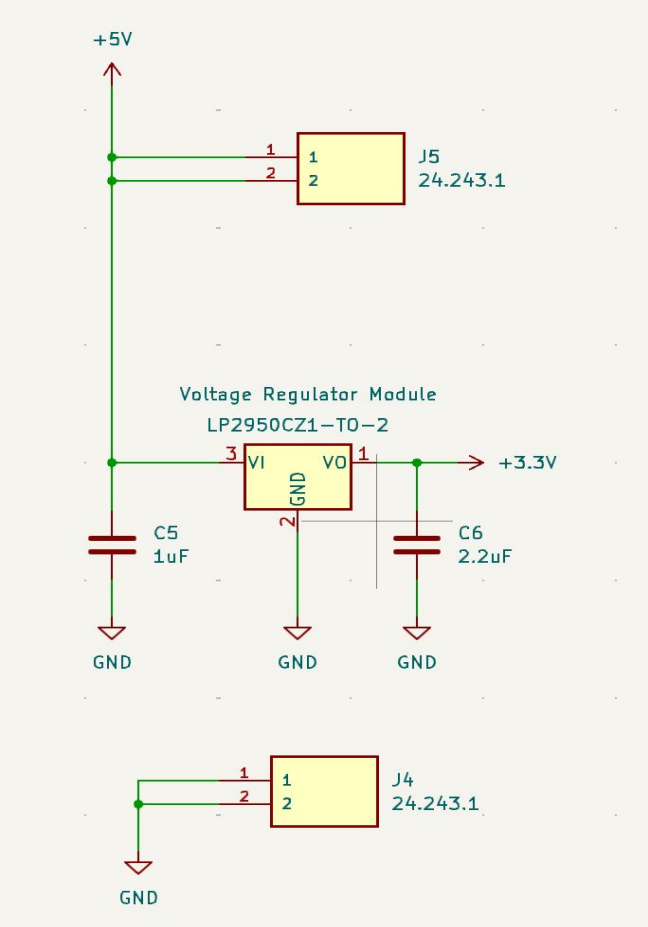
The Voltage Regulator Module idles at 5V (converted to 3.3V for microcontroller) then switches to 0 based on magnetic input

Subsystem #4
Power System

Requirements and Verification Table

Requirement	Verification
Provide adequate voltage to all components of the circuit.	Ensure multimeter reads 5V to each motor and sensor, and 3.3V to microcontroller
Provide adequate current to all components of circuit.	Ensure lab kit power supply provides at least 2.1A to account for stall current of motor
Ensure circuit never overheats under sustained maximum load	No thermal shutdown or instability observed during 10-minute continuous full-load operation

Circuit Diagram

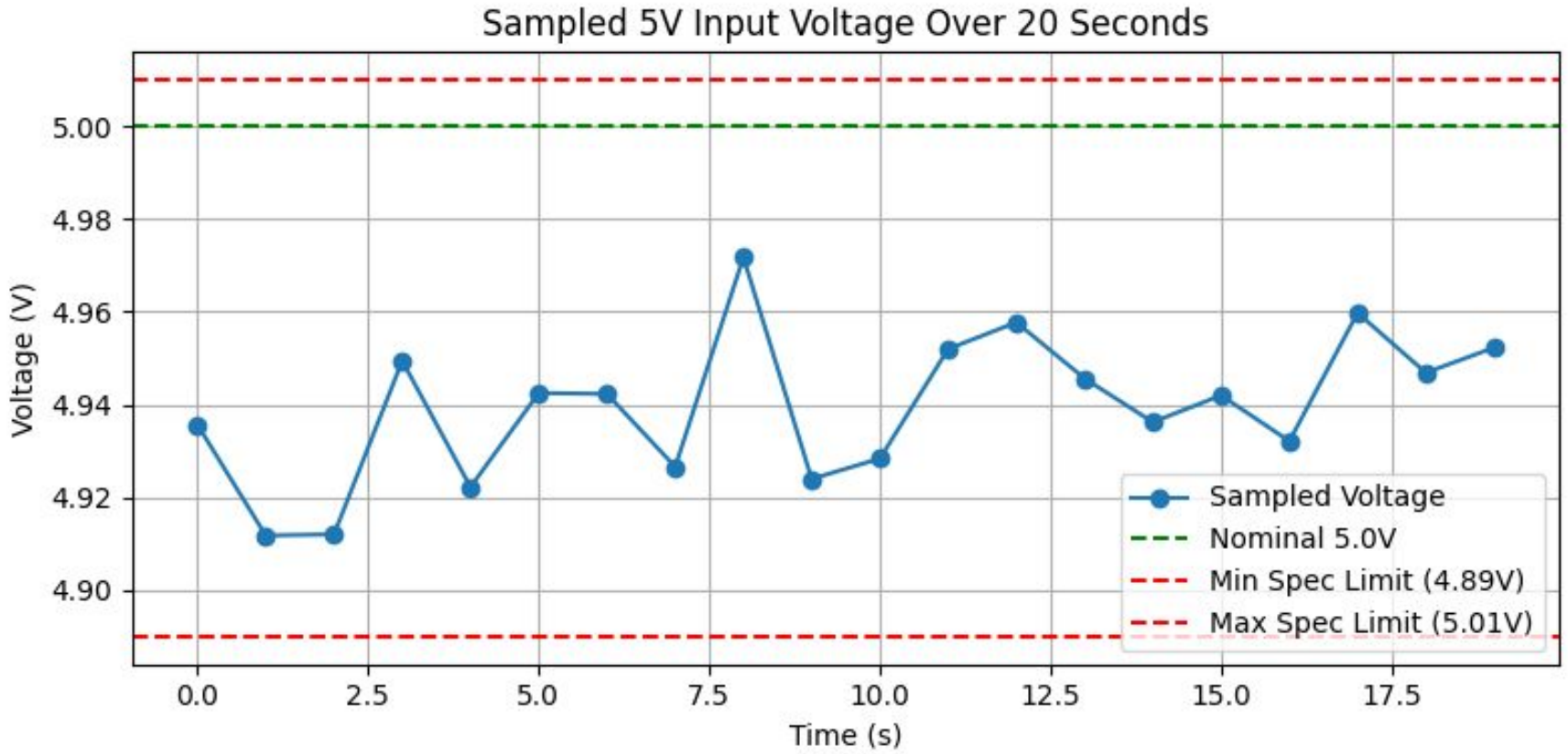


Lab kit power supply outputs 5V and 2.5A.

Microcontroller needs 3.3V, so a voltage regulator module is used to limit the voltage to the microcontroller.

Decoupling capacitors added for voltage fluctuations.

Testing 5V input result



Conclusion

Wrapping Up & Future Work

The project functions as intended: no accidental triggering of sensor, too low or high power, or record misalignment.

There could be work done to minimize external wiring (connecting sensor via drilled hole in the record player, hiding motor wiring).

Test the flipping mechanism with automated tone-arm movement for fully automated record listening experience.

Adding rubber fittings to the record grabber to ensure it does not scratch.

Thank You

Q&A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